

## KamLAND - Calibration and Monitoring

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The Kamioka Liquid scintillator Anti-Neutrino Detector (KamLAND) [1,2] is a long baseline neutrino oscillation experiment which uses Japanese commercial nuclear power plants as the neutrino source. In order to extract meaningful physics from KamLAND it will be necessary to carefully calibrate its energy and positional response, and to continuously monitor the stability of its performance. The LBNL KamLAND Calibration and Monitoring Group has accepted responsibility for designing, constructing and installing three calibration and monitoring systems: (1) A peripheral Light Emitting Diode (LED) system, (2) A “z-axis” deployment system, and (3) A “4 $\pi$ ” deployment system. The peripheral LED system consists of 30 blue LED, their tubular containers, mounting brackets, cables, and associated electrical circuits. The complete system, except for the power supplies and triggering circuits, has been installed in KamLAND. Last summer two of these LED were successfully used to test the first 50 channels of the front end electronics in the Kamioka mine. The crate housing the electronics has been delivered to LBNL, and the electronic modules to control and drive the LED have been ordered. All of these components are expected to be ready for operation in Japan when detector filling starts in May 2001. The “z-axis” deployment system will be the heart of KamLAND calibration activities. It consists of a radioactive source, a laser source, and/or a LED source attached to a cable with which they can be positioned anywhere along the vertical axis of the detector. Most of the activities during the last year centered on specifying the requirements and the design of the. Special care was taken to ensure that radon and light are not introduced into the active volume of the detector during the process of manipulating the sources. The design of the system is now essentially complete, and

current activities are devoted primarily to procuring components such as the glove box, the optical fibers, the deployment cable, the cable reel, and the optical couplers. A computer control system based on LabVIEW [3] is under development. Our goal is to assemble this system in the coming months and to have it ready for installation in Japan by late summer 2001. Detailed calibration of the KamLAND detector requires a source deployment system that can be used to position sources not only on the vertical axis, but anywhere within the active volume of the detector. To this end we are developing the so-called “4 $\pi$ ” deployment system. It has proved to be a difficult task, because it is large and unwieldy. On the one hand it must be robust, reliable, and reproducible, while on the other it should be simple, have a minimum shadow, and be fail-safe. Members of the calibration group, as well as a panel of engineering advisors, have proposed various conceptual designs, but so far none of them is completely free of drawbacks. However, we are slowly converging on a final design and we plan to have the “4 $\pi$ ” deployment system ready for installation early 2002.

### Footnotes and References

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1. <http://www.awa.tohoku.ac.jp/html/KamLAND/>

2. J. Busenitz, *et al.*, “Proposal for US participation in KamLAND”, March 1999, unpublished.

3. <http://www.ni.com/>